

Dairy Waste Pond Size Estimation

Kehoe

Rev 07/04/02

Dairy Waste Management System Evaluation

18-Aug-02

18-Aug-02

12:31 PM

Kehoe Dairy - Tim, Tom, Mike

Dairy Ranch

(415) 669-1696

Telephone

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Address

Proposed Stall Barn Expansion - Future Animal Counts

1. Confined Animal Wastes

		No. of Animals	Weight 1000 lb. unit	Equiv Days confined	Gal/manure 1000lb./day	Annual manure prod, Ac ft.	Notes. Adjust calcs in 3rd c
Milk Cows	high string	260	354	319	14.8	5.27	6m confined
1400 lbs	low strings	270	378	319	14.8	5.48	6m 6h paddock
Dry Cows		22	30.8	180	10.0	0.17	6m confined
1400 lbs.		23	32.2	180	10.0	0.18	6m confined
Yearling Heifers		30	27	180	7.0	0.10	stall barn
>900 lbs.							
Sm. Heifers		100	70	180	4.8	0.19	dry lot around barns
500-900 lbs.							
Calves		140	42	365	1.7	0.08	new east pens
avg 300 lbs.							
Dairy Totals		845	944			11.47	

2. Unconfined Animal Wastes

Animal Group		No. of Animals	Weight 1000 lb. units	Equiv Days	Gallons Manure/ 1000lb./day	Annual Manure prod. Acre Feet	
Milk Cows	high string	260	354.0	46	14.8	0.75	6mo 6h paddock
1400 lbs	low strings	270	378.0	46	14.8	0.76	6mo 6h paddock
Dry Cows		22	30.8	185	10.0	0.17	6m pasture
1400 lbs.		23	32.2	185	10.0	0.18	6m pasture
Yearling Heifers		100	90.0	365	7.0	0.70	dry lots;
>900 lbs.							
Sm. Heifers		100	70.0	185	4.8	0.19	dry lots;
500-900 lbs.							
Calves		0	0.0	365	4.8	0.00	
avg 300 lbs.							
On Site Totals		775	995			2.79	

3. Total Animal Waste

14.26 Acre Feet

4. Additions to the Confinement Waste Management System:

Notes:

24 Loads/yr sand 1.4 t/cy
0 Lb/day straw

2 % 50lb ration/day, milk strings
at 40 lb/cu ft

Imported manure, whey, other

	Tons/Year Acre Feet	
Animal Bedding	480.0	0.21
Makeup sand	tons	
Animal bedding	0.0	0.00
Straw/organic	tons	
Damaged feed	96.7	0.11
or silage	tons	
Other	0	0.00
loads		
Subtotal		0.32

Dairy Waste Pond Size Estimation

5. Wash and Process Water Produced Annually

	Rate Gal/min	Use Hr/day	Gal/Day	Ac/ft per yr	Percent of Total
Milking System Wash Water			360	0.40	20.1
Milking System Backflush			0	0.00	0.0
Milk Tank Wash Water			100	0.11	5.6
Cow Wash Water	Gal H2O/cow Milking/day	0.13 2	133	0.15	7.4
Sprinkler Pen Water			0	0.00	0.0
Milking Parlor Wash Water	10	2.00	1200	1.34	66.9
Recycled wash water, per day	0	0.00	0	0.00	0.0
Vacuum Pump Water	0	10	0	0.00	0.0
Air Comp/Milk Cooler Water	0	10	0	0.00	0.0
Leaking troughs, other losses	0	24	0	0.00	0.0
Spring flows to manure storage	0	24	0	0.00	0.0
Flush System Added Water			0	0.00	0.0
		days/year	0		
Total Wash and Process Water			1793	2.01	100.0
			Gal/day	Acre Feet	

Section IV. Rain Water Additions to Waste System

Rainfall Data for Discretionary Design

Local average annual rainfall, inches	24.0	Local average per SCWA isohyetal map, rev June 83.	3.6	25-year, 24-hr storm Inches @ avg* (3.8/25.5) = local/Petaluma.
10-year Wet-Winter Annual Rainfall, inches	35.8	10-year storm prorated based on 46 year Petaluma data with 25.5" avg annual and 38.0" 10-year wet winter (O'Connor, 2000).		

Estimate of Runoff from Dairy that Contributes to the Waste System

	Acres	Runoff Coefficient	Acre-feet	
Total Manured Surface Area	0.25	1.00	0.73	
Total Pond(s) Surface Area	2.75	1.00	8.20	
Watershed Area	0.55	0.40	0.66	
Crop/pasture	0.00	0.40	0.00	
Collection Area, Total	3.55		9.59	10-year Winter Storage Required
			1.08	25 year, 24-hour Storage Required

Pump size required to handle 25 year, 24-hour storm:

Hours pumped
per day

12

Days pumped

1

Required Pump
size, Gal/min

479

Pump Size OK?

Pump period available?
(Y/N; caps only)

N

Dairy Waste Pond Size Estimation

Section V. Total Annual Waste Flows

Total System Evaluation

Estimate Annual Waste Storage Requirement at Dairy

	Acre Feet	Percent of Total
On-Site Animal Waste	11.47	49.0
Off-site additions to system	0.32	1.4
Bedding, feed, liquids		
Wash and Process Water	2.01	8.6
Manured-area Rainfall, 10-year wet winter	9.59	41.0
Subtotal - Annual wastewater volume	23.38	100.0

baseline

Storage Reduction Adjustments

		Volume Reduction Acre-Feet	Adjusted Storage Volume Acre-Feet	% of Total	
Evaporation	Feet	0.50	1.38	22.01	84.1
Ponds rain drained before use	Feet	1.2	2.75	10.25	82.3
Solids Separation		N	0.00	10.25	82.3
Mech. Manure Separation? (Y/N; caps only)					
Slurry Transport	Gal/day	4200			
Daily drawdown of sump or pond independent of annual cleanout	Day/mo	10.0	1.54	17.71	75.7
	Mo/yr	12.0			
Irrigation Disposal	Gal/min	200			
Daily drawdown of sump or pond independent of annual cleanout	Hr/day	0.0			
	Day/mo	0.0	0.00	17.71	75.7
	Mo/yr	0.0			
Add 25-year, 24-hour storm runoff if insufficient pump capacity or cycle time			1.06	4.5	
Total Annual Waste Flows Requiring Storage Capacity			18.77	80.3	

Add
4.30
ac.ft.
if no
drain or
slurry
transport

Section VI. Evaluate Capacity of Existing Storage System

Waste Storage Capacity	Acre Feet
Design storage capacity of waste ponds. (from Areas worksheet)	18.77
Design storage capacity of other facilities. (add, if any)	
Total Storage Capacity (Add cells 18,21)	18.77
Waste Storage Capacity Reductions (Incomplete annual pond cleanout, etc)	0.00
Manure Handling and Storm Water Management Capability	
Working Storage Capacity (cell 3-cell 4)	18.77

Calculation indicates that:	Total Capacity Available
Storage Capacity is Satisfactory	
Excess Capacity Available: 0.0 Acre-Feet	18.8 Acre-Feet

Dairy Waste Pond Size Estimation

Dairy Pond Size Estimation - Data Summary Sheet

Kehoe

Kehoe Dairy - Tim, Tom, Mike

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2. Unconfined Animal Wastes	2.79 acre feet		
1. Confined Animal Wastes	11.47 acre feet		11.47 acre-feet
3. Total Animal Waste	14.26 acre feet		
4. Additions to the Confinement Waste Management System:			
Animal Bedding	Makeup sand	0.21 acre feet	
	Straw/organic	0.00 acre feet	
	Other	0.00 acre feet	0.32 acre-feet
	Damaged feed	0.11 acre feet	
Milking System Wash Water	0.51 acre feet		
Milking System Backflush	0.00 acre feet		
Cow Wash Water	0.15 acre feet		
Sprinkler Pen Water	0.00 acre feet		
Milking Parlor Wash Water	1.34 acre feet	1793 gal/day	2.01 acre-feet
Recycled wash water, per day	0.00 acre feet		
Vac Pump/Air Comp/Cooler	0.00 acre feet		
Leaks/Springs	0.00 acre feet		13.80 af wastewater
Flush System Added Water	0.00 acre feet		59 % of total
Rainfall Data for Discretionary Design			
	Acres	Coefficient	runoff, ac-ft
Manured surfaces	0.25	1.00	0.73
Pond(s)	2.75	1.00	8.20
Pond Watershed(s)	0.55	0.40	0.66
Crop/Pasture areas	0.00	0.40	0.00
Total Runoff			9.59
Collection Area,	3.55	na	9.59
Subtotal - Annual wastewater volume	Total:		23.38
Evaporation:			-1.38
Solids separator:			0.00
Rainfall drawdown:			-2.75
Slurry transport:	4200 gal/day	120 day/yr	-1.54
Daily irrigation:	200 gpm	0 hr/yr	0.00
Adjusted storage volume, acre-feet per year:	-5.67		17.71
3.58 inches	25-year, 24-hr storm	Inches @ avg*(3.8/25.5) = local/Petaluma.	
	Pump size required to handle 25 year, 24-hour storm:		1.06
	12 hr/day		
	1 day/yr	479 gal/min	0.71
Total Annual Waste Flows			18.77
Requiring Storage Capacity			15.27
Waste Storage Capacity			
	Design storage capacity of waste ponds.		18.77 acre-feet
	Design storage capacity of other facilities.		0.00 acre-feet
	Waste Storage Capacity Reductions		0.00 acre-feet
	Working Storage Capacity		18.77 acre-feet
Calculation indicates that:			
Storage Capacity is Satisfactory			Total Capacity Available
Excess Capacity Available:	0.0 Acre-Feet		18.8 Acre-Feet

Runoff and Pond Areas Calculation Worksheet

18-Aug-02

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Measure individual areas or area combinations with tape measure and report in the space provided.

1. Exposed Manured Areas at Dairy

Includes feed lots, alley ways, holding corrals, sick pens, calf lots, compost piles, solids storage areas, outside loafing areas, and similar hardened or manured areas with 100% runoff to manure storage

Area	Width	Length	Sq Ft	Location Notes	Acres
1	100	107.0	10700	milk barn concrete corrals	0.25
2					0.00
3					0.00
4					0.00
5					0.00
6			0		0.00
			10700	0.25	Used in Sec IV, Cell 4 Cell 3 / 43560.
			Square Feet	Acres	

2. Manure Pit and Liquid Storage Pond Surface Areas

Includes wastewater ponds, manure pits, flush water recycle ponds, manure sumps, etc.

Note: When measuring the waste storage capacity of ponds, include the capacity of pit(s) and other collection facilities. If more than one pond is used, measure all ponds. Allow for two feet of freeboard in the last pond when making measurements.

Pond/Pit	Width	Length	Sq Ft	Avg depth	Capacity	Location Notes	Acres
1 main	80	210		6.5	2.50	manure pit/pond	0.00
1 freeboard	85	220	18700	2.0	0.86	pit 1 freeboard	0.43
2 overflow	50	80	4000	3.0	0.28	emergency overflow	0.09
3 north	190	206	39140	4.6	4.13	North pond, existing	0.90
4 north	150	387	58000	6.3	11.00	New Pond	1.33
			0		0.00		0.00
			110940	2.75	18.77	Used in Sec IV, Cell 3, Section VI Cell 1	0.00
			Square Feet	Acres	Acres-feet		

3. Rainfall Collection Area Draining to Manure Storage Areas.

Includes tributary areas of clean water around barns and corrals that drain to manure ponds.

Area	Width	Length	Sq Ft	Location Notes	Acres
1	150	160	24000	hillside between barn and pit	0.55
2			0		0.00
3			0		0.00
4			0		0.00
5			0		0.00
			24000	0.55	Cell 3 / 43560 Used in Sec IV, Cell 4
			Square Feet	Acres	

4. Crop and Pasture Areas Draining to Manure Storage Areas

Includes tributary areas of clean water away from dairy that drain to manure ponds.

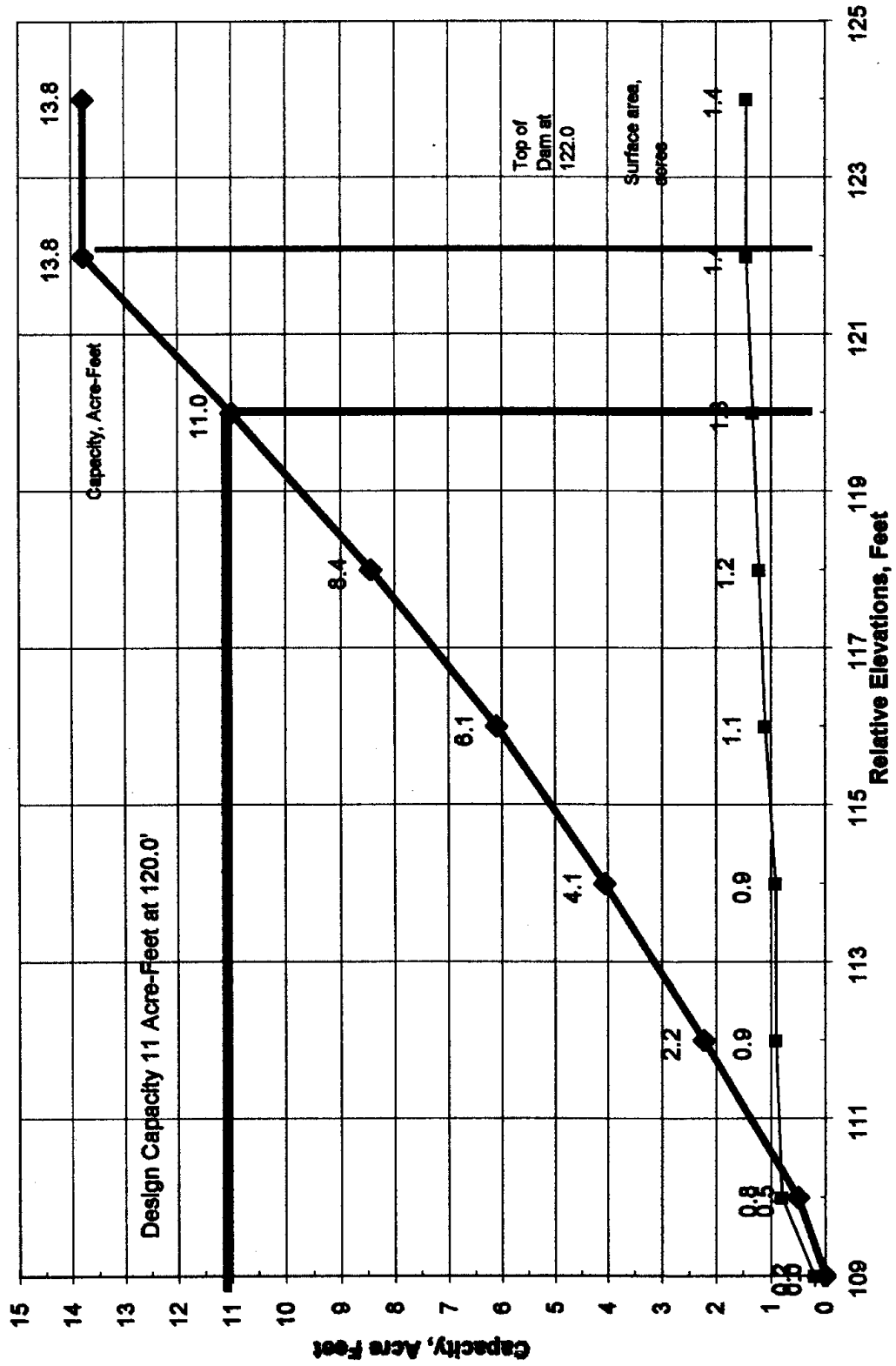
Area	Width	Length	Sq Ft	Location Notes	Acres
1			0		0.00
4			0		0.00
5			0		0.00
			0	0.00	Cell 3 / 43560 Used in Sec IV, Cell 9
			Square Feet	Acres	

Erickson Engineering Inc.
Data from CAD

Revised: 19-Aug-02

Elevation	Water Sq Ft	Avg SF	Volume Cu Ft	Cumulative Cu Ft	Water Acre-Feet	H2O Area, Acres	Sal x 10 ⁶
124.0					13.8	1.4	
122.0	63130	60620	121240	600400	13.8	1.4	4.497
120.0	58110	55675	111350	479160	11.0	1.3	3.589
118.0	53240	50888	101775	367810	8.4	1.2	2.755
116.0	48535	44443	88885	266035	6.1	1.1	1.993
114.0	40350	39975	79950	177150	4.1	0.9	1.327
112.0	39600	37478	74955	97200	2.2	0.9	0.728
110.0	35355	22245	22245	22245	0.5	0.8	0.167
109.0	9135	0	0	0	0.0	0.2	0.000
106.0		0	0	0	0.0	0.0	0.000
104.0		0	0	0	0.0	0.0	0.000
102.0		0	0	0	0.0	0.0	0.000
100.0		0	0	0	0.0	0.0	0.000
98.0		0	0	0	0.0	0.0	0.000
96.0		0	0	0	0.0	0.0	0.000
94.0		0	0	0	0.0	0.0	0.000
92.0		0	0	0	0.0	0.0	0.000
347455		311323					

Kehoe Dairy- New North Manure Pond Elevation - Volume Curves



Dairy Nutrient Budgeting Worksheet

Rev 7/04/02

Nutrient Budgeting Worksheet

Nbudget-kehoe

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This worksheet is intended to provide guidance for nutrient budgeting for management of manure produced by animals in both confined and unconfined conditions. It will partially fulfill facilities management plans as recommended by regulatory agencies.

Complete the Producer and Area worksheets prior to entering nutrient budgeting information. Provide inputs as required in empty green-shaded boxes in the Nutrient Budgeting worksheet. Calculation results are shown in non-shaded boxes.

Nutrient budgeting may include confined or unconfined animals, irrigated and non-irrigated land, fertilized or non-fertilized inputs, and may use lab or handbook data for stored manure nutrient values. Several runs of this computer spreadsheet worksheet will be needed to evaluate confined animal manures, unconfined animal manures, and individual fields, either on-site or off-site, because of the large number of possible nutrient input combinations. Take care when evaluating individual fields to include all inputs, and to eliminate duplicate accounting with such items as animals pastured elsewhere or fertilizer and irrigation water used elsewhere. Total ranch nutrient budgeting can be accomplished using total headcounts, acreages, etc., and will represent average conditions rather than site-specific conditions.

Results are based on a large number of input assumptions, and represent general nutrient budgeting trends, rather than an exact detail accounting of site-specific conditions. Detailed assessments will require concentration sampling and quantity measurements of soil, forage, crops, irrigation water, stored manure, and other inputs and outputs to the nutrient input, waste management, and nutrient consumption systems.

Section I. Producer Information

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Land Areas	On-Site Acres	Off-Site Acres	Total Acres
Total Property	1240		1240
Pasture Lands	900		900
Irrigated or dry	3	0	
All Crop Lands	180	0	180
Vineyard or Non-Dairy	120	0	120
Housing, corrals barns, other non-producing	40	0	40
	1	1a	
Total Crop and Pasture	1080	0	1080
	4	7	8
	(add cells 2, 3)	(add cells 5, 6)	(add cells 4, 7)

Section II: Pasture and Crop Nutrient Demand

Table 1. Plant Food Utilization by Various Crops

Total uptake in harvested portion. Reference: Table 4.1, Western Fertilizer Handbook

Crop	Yield	Pounds per Acre		
		N	P ₂ O ₅	K ₂ O
Field Crops				
Corn - grain	5t/180bu	240	100	240
Corn - silage	30t	250	105	250
Grain sorghum	4t / 150bu	250	90	200
Oats	1.6t/100bu	115	40	145
Wheat	3t/100bu	175	70	200
Barley	2.5t / 100bu	160	60	160
Fruit and Nut Crops				
Apples	15t	120	55	215
Grapes	15t	125	45	195
Forage Crops				
Alfalfa	8t	480	95	480
Bromegrass	5t	220	65	315
Clover-grass	6t	300	90	360
Orchardgrass	6t	300	100	375
Sorghum-sudan	8t	325	125	475
Timothy	4t	150	55	250
Vetch	7t	390	105	320

Note: These parameter values may be adjusted as desired to best match existing site conditions.

Change numbers in this table to adjust nutrient demands to reflect soils, slope, aspect, rainfall, other parameters affecting plant vigor and nutrient demand.

Dairy Nutrient Budgeting Worksheet

Coastal Dryland Pasture	200	80	175
Irrigated Pasture	275	90	300

Section III: Nutrient Composition of Manure

Nutrient concentration of manure depends on animal species and age, feed materials and additives, source of manure, storage method, length of storage, rainwater dilution, disposal method, and other factors. The most accurate nutrient budgeting estimates will be obtained if lab samples for nutrient concentration are taken from the storage area. A composite sample from several surface locations and depths within the storage is required for a representative value. The average table values shown from USDA-SCS Ag Waste Management Field Handbook are used for calculations if you do not provide site-specific nutrient concentrations.

Table 2. USDA-NRCS Ag Waste Handbook			
Nutrients, lb/day/1000lb of animal			
Nutrient Parameter	milkling	dry	heifer
Nitrogen, N:	0.45	0.36	0.31
Phosphorous, P:	0.07	0.05	0.04
Potassium, K:	0.26	0.23	0.24
Copper, Cu:		22	

Table 3. Commercial Laboratory Analysis		
of your stored liquid manure		
Parameter	If available, enter data here	
	Milligrams/liter	Equivalent lb/gal
Nitrogen, N:		0.00000
Phosphorous, P:		0.00000
Potassium, K:		0.00000
Copper, Cu:		0.00000

Section IV. Annual Production of Animal Waste for All Livestock

Nutrient quantities stored in containment facilities are estimated in one of two ways:

- 1) USDA handbook N-P-K values are used with confined animal counts and manure production estimates obtained from the Producer worksheet.
- 2) If commercial lab analysis data for N-P-K is entered above, nutrient quantities are based on the lab concentration data times the pond storage volume obtained from the Producer worksheet.

Note that total nutrient quantity estimates in storage facilities may be significantly different using the two different approaches. Lab data from the storage pond will tend to be most accurate. This is because factors affecting nutrient concentration are taken into account, including seasonal dilution, process and wash water, actual manure quantities collected, external inputs to storage, changes during storage, and similar factors. Wide variation between individual facilities can be expected.

1. Handbook Method

Animal counts from the companion Producer worksheet are multiplied by the appropriate table values for N, P, and K above to determine nutrient production.

Table 4. Unconfined Animal Nutrients				
Production based on Handbook Values				
	Unconfined Cubic Feet	Total Pounds of Nutrients		
		N	P	K
Milk Cows	32816	7473	1163	4318
1400 lbs.	34078	7761	1207	4484
Dry Cows	7607	2051	285	1311
1400 lbs.	7953	2145	298	1370
Yearling Heifers	30701	10184	1314	7884
>900 lbs.				
Sm. Heifers	8299	4015	518	3108
500-900 lbs.				
Calves	-	-	-	-
<500 lbs				
Calves	121455	0	0	0
avg 300 lbs.				
On Site Totals	121455	33628	4785	22475

Table 5. Confined Animal Nutrients			
Production based on Handbook Values			
Confined Cubic Feet	Total Pounds of Nutrients		
	N	P	K
229711	52314	8138	30226
238546	54326	8451	31388
7402	1996	277	1275
7738	2087	290	1333
4542	1507	194	1166
8075	3906	504	3024
3479	4752	613	3679
-	-	-	-
499494	120887	18467	72092

Dairy Nutrient Budgeting Worksheet

- 2. Lab Data Method:** Laboratory nutrient analysis of existing storage liquid is multiplied by existing pond storage volume to estimate total nutrient quantities in storage. Only for CONFINEMENT manure.

Note: If ponds are pumped to maintain adequate winter storage, or if storage encroaches into freeboard requirements, the working storage capacity is not a true measure of animal manure production and storage. Indicate additional storage in the box provided to account for total annual production.

Working storage capacity, from
Producer Worksheet, Section VI:
Acre-feet

-0.31

Storage
Additions,
Acre-feet

1.54

Cells G130+g134-F159 main sheet

**Table 6. Confined Animal
Manure Storage Nutrients**

Based on lab sampling data, lb.		
N	P	K
0	0	0

3. Calculation Method for Acreage Requirements:

The remainder of this worksheet is used to determine the acres required for consumption of N - P - K nutrients in keeping with good crop management practices. Application rates consistent with crop uptake needs will maximize economic benefits of applied manures and will reduce chance of impairing surface water runoff quality.

Area requirement calculations are based on total nutrients produced. Indicate in the box below if the calculations for stored liquid and solid manures should be based on: 1 = Handbook values, or 2 = Lab Data values. Unconfined animal nutrient values are based on handbook information, because lab data for grazed animal manures is difficult to obtain.

**CONFINED ONLY Animal Manure
Nutrient Calculation Method**

1

1 = Handbook Values

2 = Lab Data Values

Section V: Manure Nutrient Quantity Adjustments

1. Manure Storage Method

Nutrient losses from manure occur during collection, storage, application, and after land application. Losses can vary widely, depending on collection method, collection frequency, temperature, precipitation, type of handling system, duration, type, and location of storage, and other factors.

About half the N in fresh manure is inorganic, and subject to significant losses.

The table from Oregon State University publication EC1094 provides an estimate of NPK retained by various storage systems. Lab nutrient analyses of manure take these storage losses into account. Use these adjustment values in Table 14 and Table 16 below.

**Table 7. Percentage of Original Manure Nutrient Content
Retained by Storage System**

	N	P	K
Daily Spread	80	90	90
Dry, under roof	70	90	90
Earth storage	55	60	70
Lagoon/flush	30	40	60
Open lot	60	70	65
Pits under slats	75	95	95
Scrape/storage tank	70	90	90
None (grazing)	100	100	100

2. Manure Spreading Method

Nitrogen nutrient losses from manure can occur during spreading (Fresh manure odor is mostly volatilized ammonia). Essentially all phosphorus and potassium applied will be available to the crop. The table from OSU publication EC1094 summarizes percent nutrient delivered to cropland and available for plant uptake, based on application and preutilization losses. Use these adjustment values in Table 14 and Table 16 below.

**Table 8. Percentage of Original Manure Nutrient Content
Delivered to Crop and Available for Uptake**

	N	P	K
Injection	95	100	100
Broadcast	80	100	100
Broadcast/cultivate	95	100	100
Sprinkling	75	100	100
Grazing	85	100	100

Section VI: Additional Nutrient Inputs

1. Commercial Fertilizer

Many ranchers provide supplemental fertilizer to pasture or silage crops, on an annual or other intermittent basis. These nutrients should be accounted for in a complete nutrient budget. Fertilizer may be applied in pastures where unconfined animals are grazed, in irrigated pastures, where manure is disposed, and in crop areas. This section estimates total nutrients available based on the fertilizer formulation used, the application rate, and the application frequency. Fertilizer composition data is from Western Fertilizer Handbook, Table 5-5.

Table 9. Nutrient Value of Selected Commercial Fertilizers

Western Fertilizer Handbook Table 5-5 Fertilizer Formulation	Total Nitrogen N%	Available Phosphoric Acid P ₂ O ₅ %	Water- soluble Potash K ₂ O%
Ammonium nitrate	34		
Monoammonium phosphate	11	48	
Ammonium phosphate 1	13	39	
Ammonium phosphate 2	16	20	
Ammonium phosphate 3	27	12	
Diammonium phosphate	17	47	
Ammonium sulfate	21		
Anhydrous ammonia	82		
Aqua ammonia	20		
Sodium nitrate	16		
Urea	45		
Urea ammonium nitrate	32		
Single superphosphate		18	
Triple superphosphate		45	
Phosphoric acid		53	
Superphosphoric acid		80	
Potassium chloride			61
Potassium nitrate	13		44
Potassium sulfate			51
Sulfate of potash-magnesia			22

Indicate tons of fertilizer applied, area covered in acres, and how many years between applications for the commercial fertilizers noted. Formulations in Table 9 are used to estimate NPK application rates by fertilizer classification, using multipliers for elemental nutrients NPK.

You will need to rerun the spreadsheet to determine effects on individual fields, if all fields are not treated the same. Entering two kinds of fertilizer on a single field will result in acreage duplication in the Table 10 summary and errors in the nutrient budget summary in Table 14.

For simplicity, fertilizer nutrient values are included in both confined and unconfined animal manure disposal area evaluations, further down the spreadsheet. You will need to rerun the spreadsheet to individually evaluate confined and unconfined manure disposal areas, if both are not treated with equal amounts of commercial fertilizer.

Table 10. Commercial Fertilizer Application

Fertilizer Formulation	Fertilizer Application Data			Nutrient Summary Pounds/acre/year			
	Amount applied Tons	Area covered Acres	Application frequency Years	Total Fertilizer	N	P	K
Ammonium nitrate				0	0		
Monocammonium phosphate				0	0	0	
Ammonium phosphate 1				0	0	0	
Ammonium phosphate 2				0	0	0	
Ammonium phosphate 3				0	0	0	
Diammonium phosphate				0	0	0	
Ammonium sulfate				0	0		
Anhydrous ammonia				0	0		
Aqua ammonia				0	0		
Sodium nitrate				0	0		
Urea				0	0		
Urea ammonium nitrate				0	0		
Single superphosphate				0		0	
Triple superphosphate				0		0	
Phosphoric acid				0		0	
Superphosphoric acid				0		0	
Potassium chloride				0			0
Potassium nitrate				0	0		0
Potassium sulfate				0			0
Sulfate of potash-magnesia				0			0
Subtotals:		0 Acres		0	0	0	0

Average pounds per acre per year

2. Irrigation Water

Some dairy ranches utilize reclaimed water for irrigation purposes. This water may contain significant amounts of nutrients that must be included in the nutrient budget in order to obtain accurate results. This section estimates total nutrient availability based on lab data for the water and total application rate, in inches of water per year.

Enter nutrient concentrations in mg/l for N, P, and K. If nutrient concentrations are reported in other units, provide appropriate conversions before entering data. For example, multiply P_2O_5 by .4365 to obtain P and multiply K_2O by .8301 to obtain K.

For simplicity, irrigation water nutrient values are included in both confined and unconfined animal manure disposal area evaluations, further down the spreadsheet. You will need to rerun the spreadsheet to individually evaluate confined and unconfined manure disposal areas, if both are not treated with equal amounts of irrigation water.

 Irrigated Area: Acres per Year

 Irrigation application: inches per acre/year
Table 11. Irrigation Water Nutrients
 Commercial Laboratory Analysis of your irrigation water
 (City of Santa Rosa typical data, 1995)

Nutrient		If available, enter data here	
Parameter	Milligrams/liter	Equivalent lb/gal	
Nitrogen, N:	20.0		0.00017
Phosphorous, P:	1.2		0.00001
Potassium, K:	2.0		0.00002
Copper, Cu:	0.02		0.00000

Table 12. Irrigation Water Nutrient Application Rate
 Based on lab concentrations
 and inches/year

Pounds/acre/year	
N:	0
P:	0
K:	0
Cu:	0.0

Section VII: Manure Management on Available Acreage**1. Unconfined Animals on Seasonal Pastures:**

Unconfined animals are grazed on pasture or crop stubble, with manure spread naturally by the animals. All manure nutrient content is retained by the system, and the only losses are due to denitrification prior to plant uptake. Evaluate nutrient budgeting for unconfined animals by comparing annual NPK production to recommended NPK uptake for forage production on available acreage.

Indicate grazed acreage in Table 13 below. Nutrient demand is estimated based on published values in Table 1 above. Compare your yield values to those stated in Table 1. If your yields are significantly higher or lower, adjust the Table 1 nutrient demand values up or down to reflect actual crop demand based on local productivity.

Table 13. Grazed acreage for unconfined animals.

		On-Site	Nutrient Demand, Pounds		
	Acres		N	P ₂ O ₅	K ₂ O
Field Crops					
Corn - grain			0	0	0
Corn - silage			0	0	0
Grain sorghum			0	0	0
Oats			0	0	0
Wheat			0	0	0
Barley			0	0	0
Fruit and Nut Crops					
Apples			0	0	0
Grapes			0	0	0
Forage Crops					
Alfalfa			0	0	0
Bromegrass			0	0	0
Clovergrass			0	0	0
Orchardgrass			0	0	0
Sorghum-sudan			0	0	0
Timothy			0	0	0
Vetch			0	0	0
Dryland Pasture	400.0		80000	32000	70000
Irrigated Pasture			0	0	0
Subtotals:	400.0	acres	80000	32000	70000
		pastured			

Table 14. Unconfined Animal Nutrient Balance Estimation

Note: This evaluation for grazed pasture areas is based on handbook nutrient values, since lab data for animal-distributed manure is difficult to obtain. It assumes that common acreage is used for livestock pasture and application of both commercial fertilizer and irrigation water. Unconfined animal counts are reported in the Producer worksheet. Return to previous sections if necessary to adjust animal counts, acreages, irrigation application, and commercial fertilizer application so that a valid evaluation may be made for pastured areas where unconfined animals are kept. Acre counts for Pastured, Irrigated, and Fertilized should be the same. Acres used for nutrient consumption should be equal to or less than total available on-site and off-site acres.

Acreage	400.0 Pastured acres (Table 14)	1080 On-site acres (Section 1)
Check:	0 Irrigated acres (Table 11)	0 Off-site acres (Section 1)
	0 Fertilized acres (Table 10)	1080 Total acres (Section 1)

1. Nutrient Inputs:

	N	P	K
Table 4: NPK Production, lb:	33628	4785	22475 lb/yr
Table 7: Storage adjustment (grazing)	1.00	1.00	1.00
Table 8: NPK delivery adjustment:	0.85	1.00	1.00

Revise these adjustments to match your operation.

Estimated manure application rate by grazing animals:

9 tons/acre

Based on Table 5 animal production quantities, pastured acres.

Available from manure:	Manure NPK available, lb:	28584	4785	22475 lb/yr
External Inputs:	Manure NPK available, lb/ac:	71	12	56 lb/ac
	Table 10: Comm'l Fert, lb NPK/ac:	0	0	0 lb/ac
	Table 12: Irrig Water, lb NPK/ac	0	0	0 lb/ac
Subtotal Inputs:		71	12	56 lb/ac

2. Crop Nutrient Demands:

	N	P	K
Adjustment factor for elemental nutrient:	1.0000	0.4365	0.8301
Table 13: Adjusted NPK requirement, lb:	200	35	145 lb/ac

3. Nutrient Balance:

Subtotal Manure, Fertilizer, Irrigation Inputs, lb/yr:	71	12	56 lb/ac
Subtotal Crop and Pasture Consumption, lb/yr:	200	35	145 lb/ac
Difference, Inputs minus Outputs, lb/yr:	-129	-23	-89 lb/ac

Dairy Nutrient Budgeting Worksheet

4. Nutrient Application Recommendations

Analysis based on total pastured acres.

71 lb/ac N applied. Additional N permissible.
12 lb/ac P applied. Additional P permissible.
56 lb/ac K applied. Additional K permissible.

129 lb/ac additional N permissible.
23 lb/ac additional P permissible.
89 lb/ac additional K permissible.

2. Confined Animal Manure Disposal on Remote Fields:

Manure from confined animals is normally applied to pasture or crop stubble. The nutrient budget evaluation may be completed using either handbook values or lab analysis values. Manure nutrient quality may be adjusted for storage losses and application losses. Evaluate nutrient budgeting for seasonally-confined animals by comparing annual N-P-K production in storage to recommended N-P-K uptake for forage production on disposal acreage.

Table 15. Manure disposal acreage for confined animals.

	On-Site Acres	Nutrient Demand, Pounds		
		N	P ₂ O ₅	K ₂ O
Field Crops				
Corn - grain		0	0	0
Corn - silage		0	0	0
Grain sorghum		0	0	0
Oats		0	0	0
Wheat		0	0	0
Barley		0	0	0
Fruit and Nut Crops				
Apples		0	0	0
Grapes		0	0	0
Forage Crops				
Alfalfa		0	0	0
Bromegrass		0	0	0
Clovergrass		0	0	0
Orchardgrass		0	0	0
Sorghum-sudan		0	0	0
Timothy		0	0	0
Vetch		0	0	0
Dryland Pasture	350.0	70000	28000	61250
Irrigated Pasture		0	0	0
Subtotals:	350.0	70000	28000	61250
		acres		
		spread		

acres
spread

Table 16. Confined Animal Nutrient Balance Estimation

Note: This evaluation for pasture and crop areas assumes that common acreage is used for stored manure disposal and application of both commercial fertilizer and irrigation water. Confined animal counts are reported in the Producer worksheet. Return to previous sections if necessary to adjust animal counts, confinement season, acreages, irrigation amounts, and commercial fertilizer amounts so that a valid evaluation may be made for pasture or crop areas where confined animal manures are disposed. Acre counts for Pastured, Irrigated, and Fertilized areas should be the same. Acres used for nutrient consumption should be equal to or less than total available on-site and off-site acres.

Acreage	350.0 manure disposal acres (Table 15)	1080 On-site acres (Section 1)
Check:	0 irrigated acres (Table 11)	0 Off-site acres (Section 1)
	0 fertilized acres (Table 10)	1080 Total acres (Section 1)

Handbook values used for Liquid Manure nutrient estimation.

1. Nutrient Inputs:

	N	P	K
Table 4: NPK Production, lb:	120887	18467	72092
Table 7: Storage Adjustment (Earthen):	0.55	0.60	0.70
Table 8: Delivery Adjustment (Broadcast):	0.80	1.00	1.00

Revise these parameters to match your operation.

(All storage adjustments = 1.00 for lab data approach)

Dairy Nutrient Budgeting Worksheet

Required manure application rate for disposal:

3 tons/acre

Based on Table 5 animal production quantities, spread acres.

		N	P	K
Available from manure:	Manure NPK available, lb:	53190	11080	50464 lb/yr
	Manure NPK available, lb/ac:	152	32	144 lb/ac
External Inputs:	Table 10: Comm'l Fert, lb NPK/ac:	0	0	0 lb/ac
	Table 12: Irrig Water, lb NPK/ac	0	0	0 lb/ac
	Subtotal Inputs:	152	32	144 lb/ac

2. Crop Nutrient Demands:

	N	P	K
Adjustment factor for elemental nutrient:	1.0000	0.4365	0.8301
Table 15: Adjusted NPK requirement, lb:	200	35	145 lb/ac

3. Nutrient Balance:

Subtotal Manure, Fertilizer, Irrigation Inputs, lb/yr:	152	32	144 lb/ac
Subtotal Crop and Pasture Consumption, lb/yr:	200	35	145 lb/ac
Difference, Inputs minus Outputs, lb/yr:	-48	-3	-1 lb/ac

4. Nutrient Application Recommendations

Analysis based on total manure disposal acres.

152 lb/ac N applied. Additional N permissible.
32 lb/ac P applied. Additional P permissible.
144 lb/ac K applied. Additional K permissible.

48 lb/ac additional N permissible.
3 lb/ac additional P permissible.
1 lb/ac additional K permissible.

Table 17. Fertilizer Economic Value

Relative value of animal manure and irrigation water nutrients may be determined by comparison to commercially available bulk granular fertilizer. Enter comparative retail costs for Ammonium sulfate (16-20-0) and for Potassium Chloride KCl (0-0-60) below for use as benchmark values. Handling and spreading costs vary for each producer and are not considered in the evaluation.

Animal manures as fertilizer provide additional intangible benefits such as micronutrients, microbial populations, and organic matter for soil building.

1. Benchmark economic values

Enter current fertilizer costs

Ammonium Sulfate (16-20-0), bulk granular delivered to ranch:

\$ 200.00 per ton

Potassium Chloride (0-0-60), bulk granular delivered to ranch:

\$ 270.00 per ton

	N	P	K	
Equivalent value, \$/lb:	\$ 0.0160	\$ 0.0087	\$ 0.0672	
Unconfined animal manure	\$457	\$42	\$1,511	\$2,010 unconfined
Confined animal manure	\$851	\$97	\$3,393	\$4,341 confined
Irrigation water	\$0	\$0	\$0	
Applied Nutrient Values:	\$1,308	\$138	\$4,905	Total Values

Total Applied Nutrient Value: \$6,351

This Nutrient Budgeting worksheet was developed to assist dairy ranch operators in evaluating waste management facilities and non-point source nutrient loading on their property, in order to better manage manures and protect fresh water resources. Developing and implementing a waste management plan based on appropriate management strategies will aid in preventing code violation through discharge of nutrient-laden materials into the waters of the region. The plan is the effort of the Gold Ridge Resource Conservation District, in cooperation with the University of California Cooperative Extension, Sonoma Marin Animal Waste Committee, North Coast Regional Water Quality Control Board, Natural Resource Conservation Service, and Western United Dairymen. The plan is a self-monitoring aid and may be used by anyone. The document may be copied and used freely. No warranty is expressed or implied and the authors are not responsible for facilities construction or operation or management decisions made on the basis of program outputs. Credit to the authors will be appreciated. L.R. Erickson Ph.D. Gold Ridge RCD.